

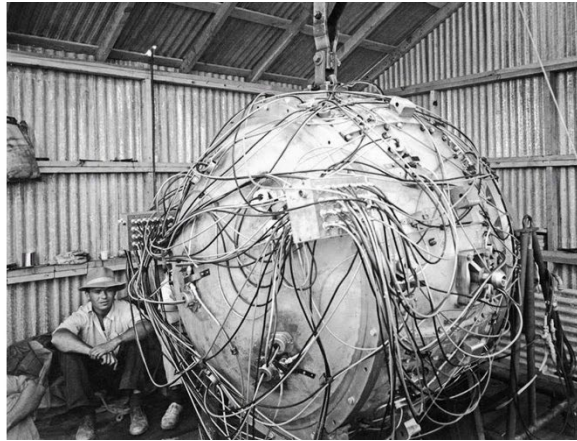
Dr. Vladimir Gurevich, Professor Emeritus

THE PROBLEMS OF EMP PROTECTION OF CIVILIAN CRITICAL INFRASTRUCTURE: WHO IS TO BLAME AND WHAT IS TO BE DONE



First case of EMP registration

July, 1945



Hoisting to a tower (left) and preparation of the nuclear explosive mounted on a tower (right) on **Trinity** range.



Data collection center

Enrico Fermi determined that nuclear explosion affected by X-ray emission, leads to ionization of air over a large area resulting in a high difference of potentials in the atmosphere (similar to lightning discharge). That is why all signal cables were thoroughly shielded and dug into the ground. However, despite all preventive measures, **many types of data-acquisition equipment were knocked out of service during the explosion by a high-voltage pulse.**

It should be noted that **electronic equipment of that time was made of vacuum tubes** i.e. it was rather primitive, unsophisticated and far less sensitive compared to modern micro-processor-based measuring equipment.

This was the first ever registered impact of EMP onto electronic equipment.

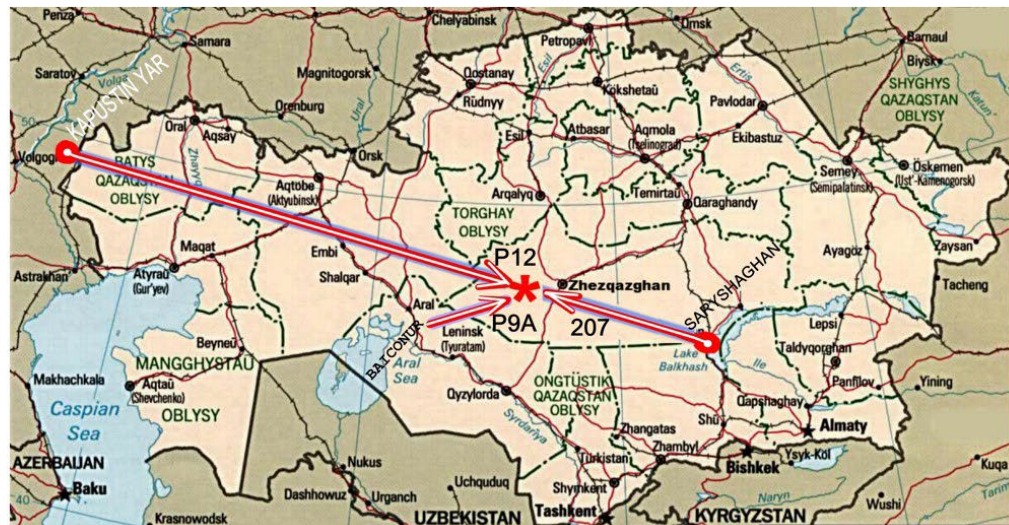
“K-3” project in Kazakhstan in 1962

Placement of **R-12 missile** (SS-4 NATO) on a launching cradle

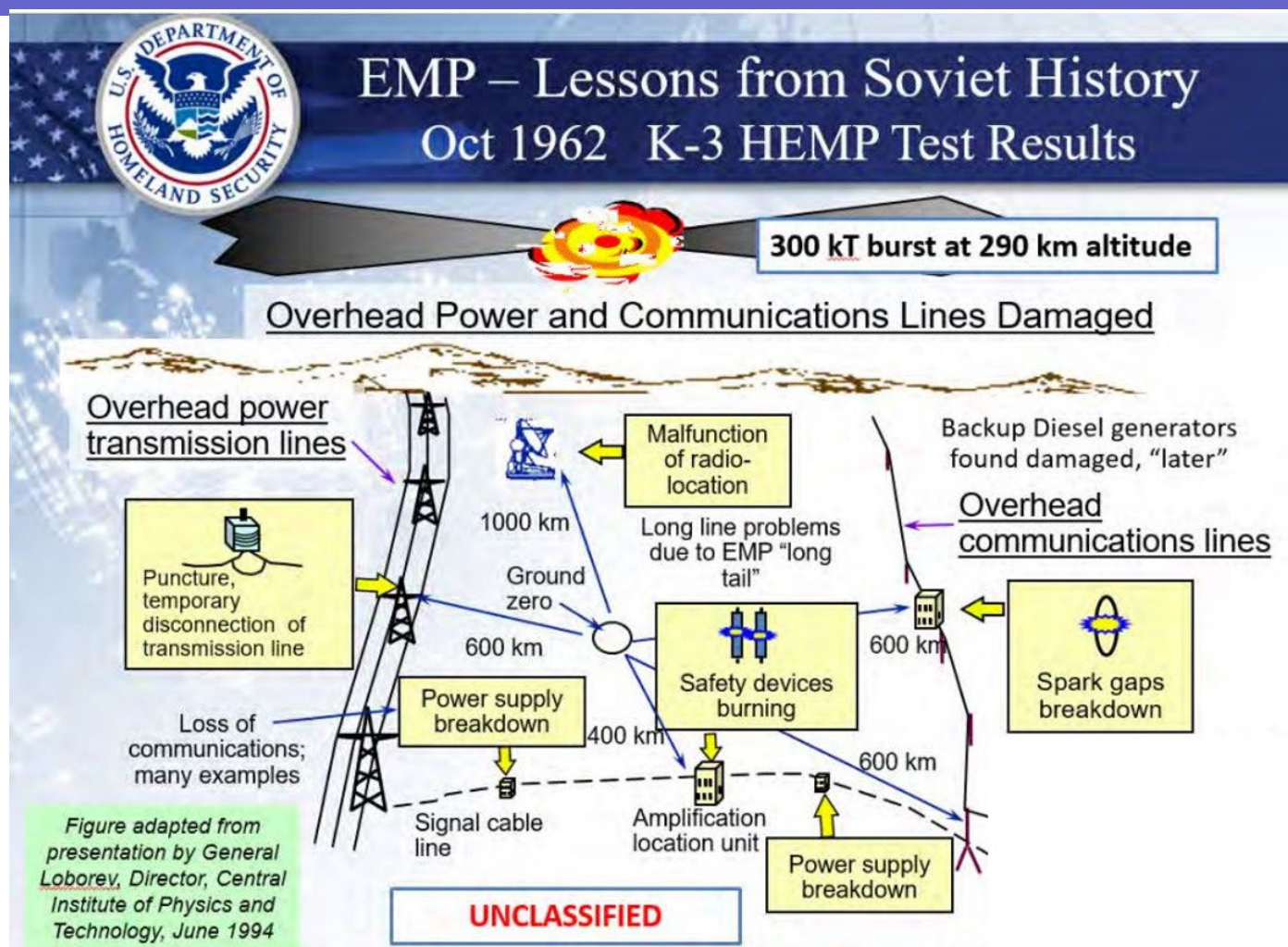
Especially for EMP impact testing experimental high altitude nuclear explosion named “**K-3**” was performed in the Soviet Union (at Kazakhstan, 180 km west of Dzhezkazgan town) on **October 22, 1962** (300 kt yield, at altitude 290 km)



Map of Kazakhstan with trajectories of **R-12 missile** (from Kapustin Yar), 207 type missiles (from Sary-Shagan) and SS-8 Sasin (from Baikonur) launched within “K-3” project

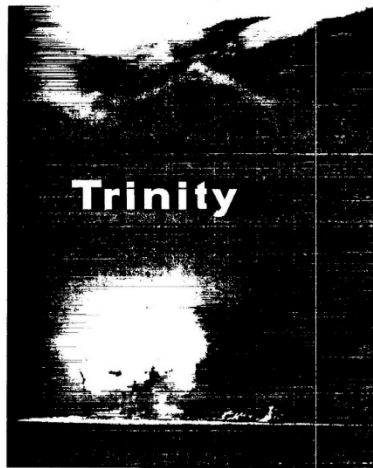


“K-3” project in Kazakhstan in 1962



Declassified versions of project's reports (1976 - 1977)

LA-6300-H
History



Los Alamos
scientific laboratory
of the University of California
LOS ALAMOS, NEW MEXICO 87545
An Affirmative Action/Equal Opportunity Employer

UNITED STATES
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
CONTRACT W-7405-ENG-36

UNCLASSIFIED ITR-1655
This document consists of 56 pages.
No. 159 of 190 copies, Series A

(No WT issued)

Operation HARDTACK
Preliminary Report

Project 9.2b

OPERATION OF BALLOON CARRIER FOR
VERY-HIGH-ALTITUDE NUCLEAR DETONATION

DECLASSIFIED BY DEMA (OPSS1)
NTPS REVIEW
DISTRIBUTION STATEMENT A
APPROVED DATE 14 Feb 1977

HEADQUARTERS FIELD COMMAND,
ARMED FORCES SPECIAL WEAPONS PROJECT
SANDIA BASE, ALBUQUERQUE, NEW MEXICO

19970306 013

UNCLASSIFIED

68-008,621

stage nuclear device was used (Figure 10.4). The wide band width and large dynamic range of the system permitted recording of the high-frequency initial spike at the 240-mile range.

Shot Cactus did not trigger the Kusaie scopes, which were set for a trigger level of 0.5 volts/meter.

Shot Fir (see Figures 10.6 and 10.7). This shot triggered all scopes at Wotho.

Note also the small positive signal occurring immediately before the main negative spike.

No scopes were triggered at Kusaie. Field strength was not up to the predicted value. Prominence of the higher frequencies in the initial pulse may have been responsible for the lack of trigger, since the higher-frequency components tend to be greatly attenuated at the 450-mile range.

Shot Nutmeg (see Figures 10.8 and 10.9). At Wotho, all scopes triggered and wave forms were recorded (Figure 10.8).

A small positive spike was noted on the Shot Nutmeg wave form, as on Shot Fir. The range was 100 miles for each of these shots. Peak negative-field strength was greater than predicted at both Kusaie and Wotho. Local shielding, consisting of two walls of lead-loaded paraffin, perpendicular to each other, could have produced a corner-reflector effect. This could have produced greater field strength, especially at the higher frequencies.

At Kusaie, all scopes were triggered by interference at minus one half second. Consequently, no data was recorded other than on the Tektronix 517, which did not require resetting of the trigger.

Data presented in Table 10.1 indicate the following correlations and conclusions: (1) The presence of a second stage in a thermonuclear weapon can be detected within certain range and system-band-width limitations. (2) Correlations of first and second crossover points with total yield, noted in previously recorded wave forms, are supported by these measurements. (3) The correlation of negative-field strength with yield is also supported by these measurements.

(4) In order to obtain wave forms with good correlations on all of the above items, system band-width should be at least 15 Mc. (5) The different wave form recorded from Shot Yucca indicates that high-altitude bursts can be differentiated from surface bursts. (6) The prediction method used (based on Operation Redwing final report data), is valid at ranges up to 250 miles, provided both shielding and [redacted] are taken into consideration.

10.4 EFFECTS OF NUCLEAR DETONATIONS ON THE IONOSPHERE

This project originally had as its prime objective the determination of the effects of high-altitude large-yield nuclear detonations on the ionosphere, and on signals propagated via the ionosphere. After Shots Teak and Orange were rescheduled, no suitable station locations could be found for relocation of the project equipment, so this project objective was changed. The new objective was to increase the recorded knowledge about ionospheric effects of large-yield surface detonations.

This project was divided into two elements: Wake Island, the northern station, and Kusaie,

350

Pages 351, 352, and 353
are deleted.

7. SUMMARY OF NUCLEAR PHYSICS MEASUREMENTS (ROBERT R. WILSON)

We can understand the difficulty of transmitting signals during the explosion when we consider that the gamma rays from the reaction will ionize the air and other material within hundreds of yards. Fermi has calculated that the ensuing removal of the natural electrical potential gradient in the atmosphere will be equivalent to a large bolt of lightning striking that vicinity. We were plagued by the thought that other such phenomena might occur in an unpredictable or unthought of manner. All signal lines were completely shielded, in many cases doubly shielded. In spite of this many records were lost because of spurious pickup at the time of the explosion that paralyzed the recording equipment.

EMP became known to the world 50 years ago

Many reports and standards now unclassified and available for distribution unlimited

International Journal of Research and Innovation in Applied Science (URIAS) | Volume I, Issue VI, September 2016| ISSN 2454-6194

EMP and Its Impact on Electrical Power System: Standards and Reports

Dr. Vladimir Gurevich

Central Electric Laboratory, Israel Electric Corp., POB 10, Haifa 31000, Israel

Abstract: The purpose of the given publication is to give to civil specialists the information on accessible standards and reports in the field of EMP/HEMP which they can use at an estimation of danger of EMP for the power electrical and electronic equipment and development of means of protection.

Key words: high altitude electromagnetic pulse, HEMP, EMP, geomagnetically induced currents, GIC, intentional destructive electromagnetic impacts.

The problem of intentional destructive electromagnetic impacts on electronic and electric equipment became apparent a few years after the USA conducted a series of nuclear test explosions coded "Operation Crossroads" on Bikini Atoll in the Marshall Islands (3800 km south-west of Hawaii) in 1946. During those test explosions a new physical phenomenon was discovered: the emergence of a powerful impulse of electromagnetic emission, encompassing an extensive area, which immediately caught the attention of military men. From 1958 until 1962 both the USA and the Soviet Union conducted a series of high burst tests (40 to 450 km) in order to investigate this phenomenon. It was revealed that the High Altitude Electromagnetic Pulse (HEMP) can destroy electronic equipment, communication systems, radio-stations and radar from a distance of thousands kilometers from the center of the explosion. At that time information about this phenomenon was kept quiet. Recently, however, it has become known that since the 1980s several countries started to put their efforts into the development of a so-called "super-EMP" nuclear weapon, where the EMP (electromagnetic pulse) effect is significantly magnified compared to an ordinary nuclear weapon.

The problem of intentional destructive electromagnetic impacts on electrical power systems becomes recently more and more actual in connection with two modern trends: an extending application of microelectronics and microprocessor-based devices and systems in electric power industry - on the one hand, and intensive designs special equipment for distance destruction of electronic devices and systems - with another. The most powerful method for such destruction is the HEMP as a result of high-altitude nuclear explosion. The history of experimental high-altitude nuclear explosions includes already half a century. During this time many tens the scientific reports and standards in details presenting this phenomenon and measures of protection from it, have been published. But great part of these reports was not

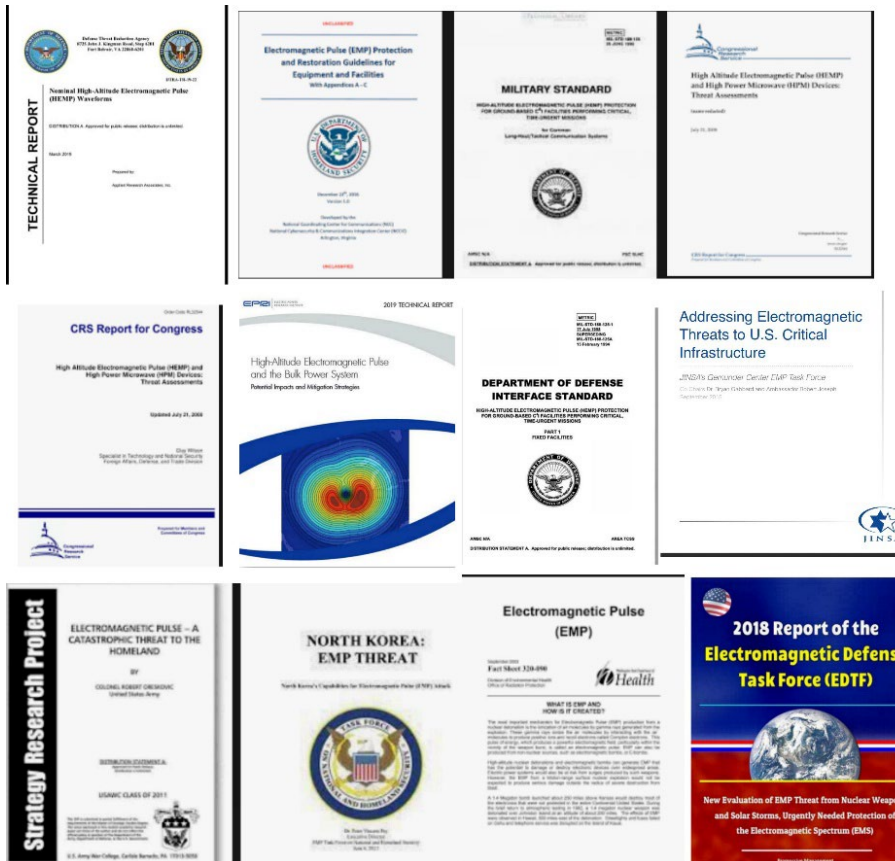
published widely and was not available for civilian engineers. Therefore, a civilian specialists working in the various technical sectors had no idea until recently about this phenomenon, or of the dangers that it posed (and some are still not aware even now).

Today, the most restricted before reports can be free downloaded from Internet, but the problem of civilian engineers is absence information about such reports and standards. Purpose of the article is informing civilian specialists in power engineering about lots of reports and standards which now available for use.

STANDARDS

1. Standards of International Electrotechnical Commission:

- 1.1 IEC TR 61000-1-3 Electromagnetic compatibility (EMC) - Part 1-3: General—The effects of high-altitude EMP (HEMP) on civil equipment and systems.
- 1.2 IEC 61000-1-5 High power electromagnetic (HPME) effects on civil systems.
- 1.3 IEC 61000-2-9 Electromagnetic compatibility (EMC)—Part 2: Environment—Section 9: Description of HEMP environment—Radiated disturbance. Basic EMC publication.
- 1.4 IEC 61000-2-10 Electromagnetic compatibility (EMC)—Part 2-10: Environment—Description of HEMP environment—Conducted disturbance.
- 1.5 IEC 61000-2-11 Electromagnetic compatibility (EMC)—Part 2-11: Environment—Classification of HEMP environments.
- 1.6 IEC 61000-2-13 Electromagnetic compatibility (EMC)—Part 2-13: Environment—High power electromagnetic (HPME) environments—Radiated and conducted.
- 1.7 IEC 61000-4-23 Electromagnetic compatibility (EMC) - Part 4-23: Testing and measurement techniques - Test methods for protective devices for HEMP and other radiated disturbances.



50 Years with the Problem

USA Only...

- Metatech Corp.
- Department of Homeland Security (DHS)
- EMP Commission of Congress
- North American Electric Reliability Corp. (NERC)
- Department of Energy
- Department of Defense (DoD)
- Critical Infrastructure Partnership Advisory Council (CIPAC)
- Electric Infrastructure Security Council (EICS)
- Defense Science Board (DSB)
- US Strategic Command (USSTRATCOM)
- Defense Threat Reduction Agency (DTRA)
- Defense Logistics Agency (DLA)
- Air Force Weapons Laboratory
- FBI
- Sandia National Laboratories
- Lawrence Livermore National Laboratory (LINL)
- Oak Ridge National Laboratory
- Idaho National Laboratories
- Los Alamos National Laboratories
- Martin Marietta Energy Systems, Inc.
- National Security Telecommunications Advisory Committee
- Federal Emergency Management Agency (FEMA)
- National Academy of Science
- Task Force on National and Homeland Security
- House Armed Services Committee (HASC)
- EMPrimus
- SARA Inc.
- EMPact America
- Federal Energy Regulatory Commission (FERC)
- Electric Power Research Institute (EPRI)
- NASA
- U.S. Northern Command (NORTHCOM)
- SHIELD Act
- EMP Grid Services
- EMP Technology Holding
- Field Management Services
- Strategic National Risk Assessment (SNRA)
- Walpole Fire Department
- Act for America
- DipiPlex
- CASI
- EMP Engineering
- Roxtec International
- Hardened Structures
- Small Business Innovation Research (SBIR)
- Secure the Grid Coalition
- JINSA's Gemunder Center EMP Task Force
- CENTRA Technology, Inc
- Page
- Federation of American Scientists
- Logistics Management Institute
- DVO Consulting
- MDW Associates
- The Defense Systems Information Analysis Center (DSIAC)

How many are in Israel?

50 Years with the Problem



EXECUTIVE ORDERS

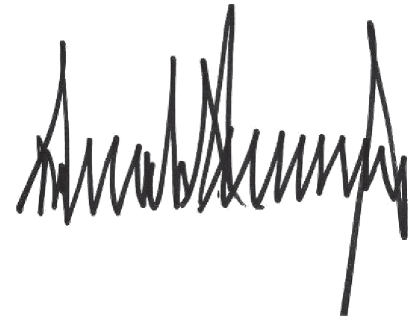
Executive Order on Coordinating National Resilience to Electromagnetic Pulses

— INFRASTRUCTURE & TECHNOLOGY

| Issued on: March 26, 2019



DONALD J. TRUMP

A stylized, handwritten signature of Donald J. Trump in black ink.

THE WHITE HOUSE,
March 26, 2019.

And now the main question after everything mentioned above: Why?

“the current state of EMP protection is random, disoriented, and uncoordinated.”

Professor George H. Baker in Testimony before
the House Committee on National Security and
House Committee on Oversight and
Government Reform (May, 2015)

This “**current state**” has already existed for 50 years. Why?

So, the problem of the destructive impact of EMP on electrical and electronic equipment has been known for many decades, however, in no country in the world has critical civilian infrastructure actually been protected!

But why?

Aren't there dozens of **scientific reports** on this topic?

Aren't there **standards**?

Isn't there **protection equipment** available on the market?

No, all of this exists, but critical civil infrastructure around the world has remained unprotected for all these decades from first nuclear explosion.

But why?

(Organizations that work in this field really don't like this question. But isn't it relevant?)



There are two aspects to the problem: technical and organizational

According to my analysis of the situation, I identified **4 main technical problems** and **4 main organizational problems**.

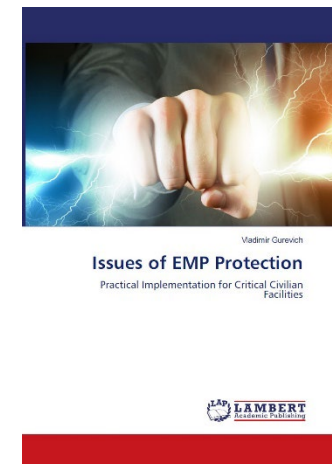
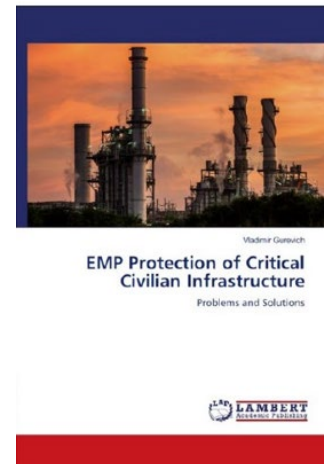
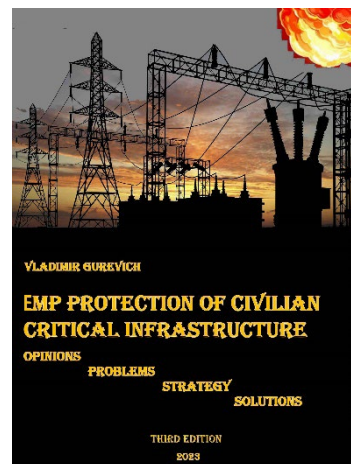
The overall analysis is provided in the article:

International Journal of Electrical and Electronics Research ISSN 2348-6988 (online)
Vol. 14, Issue 3, pp: (1-6), Month: July - September 2026, Available at: www.researchpublish.com

The Problem of EMP Protecting Critical Civilian Infrastructure: Who Is to Blame and What Is to Be Done?

¹Dr. Vladimir Gurevich

and detailed analysis in the books:



Just one example for **technical** problem (a common and very dangerous illusion!)



“The problem is not the technology. We know how to protect against it. It’s not the money, it doesn’t cost that much. The problem is the politics. It always seems to be the politics that gets in the way”.

Dr. Peter Vincent Pry, Executive Director of the Task Force on National and Homeland Security

Testimony of Dr. George H. Baker before the Senate Homeland Security Committee



Testimony of Dr. George H. Baker
Professor Emeritus, James Madison University
Director, Foundation for Resilient Societies

United States of America
Before the
Senate Committee on Homeland Security and Governmental Affairs
February 27, 2019

“The U.S. military already has EMP protection approaches that are practical, affordable, tested and well understood that can be translated directly to electric power grid control facilities and supervisory control and data acquisition electronics and networks.”

Unfortunately, this is a very common and very dangerous illusion that is replicated by people who are very far from the technical problems of the civil infrastructure sector!

Just one example of **organizational** problem (we are ready to improve our understanding...for 22 mln)



Critical Infrastructure Security and
Resilience Research, Development,
Test, and Evaluation Spend Plan

April 25, 2022
Fiscal Year 2022 Report to Congress



We know how to protect against it

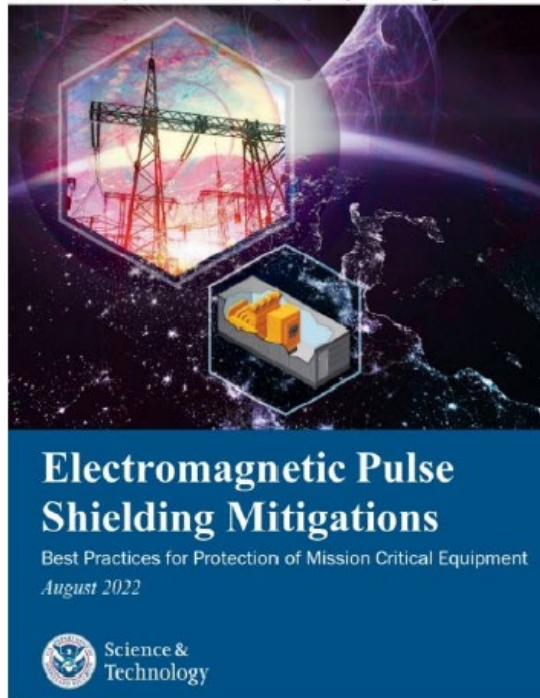
But we need to improve our understanding
after 50 years of study.

**For \$22 million, we are ready to
improve our understanding**



S&T Project	Purpose	Funding (\$)	Funds Obligation Timeline
Focus Area 2: Electromagnetic Pulse and Geomagnetic Disturbance Resilience Capabilities			
CISRR - EMP and GMD Resiliency	Improve our understanding of the effects of EMP/GMD events on communications infrastructure (and other critical infrastructure) and drive research activities to provide practical, data-driven, specific, and actionable information, concepts, techniques, technologies, and tools to critical infrastructure owners and operators to implement to protect their current and future communication systems from the impacts of an EMP event.	\$22,750,000	FY 2022- 2025

Just one example of **organizational** problem (outstanding achievement in EMP protection)



"Outstanding achievement" of the DHS Science and Technology Directorate

186 years after Michael Faraday



We know what to do!

We don't know what to do!



"Much of the available information is not specifically applied to electric utilities, making it very difficult for utilities and regulators to understand effective options for protecting energy infrastructure".

Robin Manning, Vice president for transmission and distribution for the Electric Power Research Institute (EPRI)



"I don't mean to be so flippant, but there really aren't any solutions to THIS, so I would just leave it at that

**General M. V. Hayden
Ex-Director of the National Security Agency (NSA);
Ex-Director of the Central Intelligence Agency (CIA)**



"Managing that kind of threat right now — no one really has the resources to do that"

Richard Mroz, president of the New Jersey Board of Public Utilities



"I don't think we have an illusion we will prevent it. That's really the government's job"

Mike Bryson, vice president of operations for the Valley Forge, Pennsylvania-based operator.

**everything has been known for a long time and we know what to do*

** nothing is known and we do not know what to do*

** if we do not know what to do, then we do not need to do anything*

50 Years with the Problem. Why?

The staff of energy companies, water supply companies, communications, railways, medical centers, etc., **will really deal** with the problem of EMP in only two cases:

if it's profitable for them
or
if they're forced to do it

The current situation is that there's **no profit in it** (only extra costs), and on the other hand, **no one is forcing them** to deal with it.

So, there's no interest at all

למה אני בכלל צריך את כל זה?!



Only one way left to ensure the protection of the country's critical infrastructure

There will never be any economic interest. Therefore, there is only one way left to ensure the protection of the country's critical infrastructure: **force the leaders of this infrastructures.**

How do you make that happen?

All of the above problems are solved together and very easily, with just one government decision: creating a single National Coordination Center (NCC) in the country with a technical laboratory included.

Such a center should have the appropriate authority with the right to require all infrastructural organizations to take measures to protect their specific facilities and systems from EMP.

The purpose of the lab is to provide technical practical assistance in ensuring EMP protection for these infrastructure facilities.

Only one way left to ensure the protection of the country's critical infrastructure

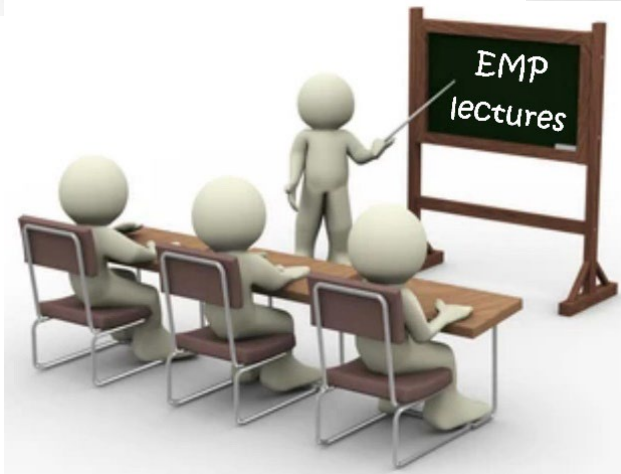
According to the author's belief and based on his **many years of personal experience** creating numerous EMP protection means, his long work within a state energy company, as well as his role as the head of a private company, and his interactions with management of ministries and government agencies, this longstanding problem can't be solved in the country without establishing the single coordinating center mentioned above

(following the example of the cybersecurity coordination center)

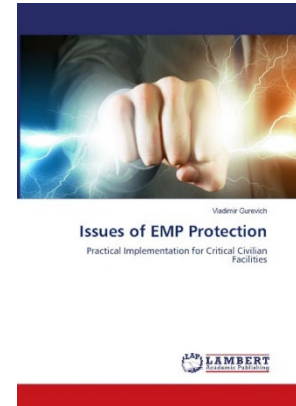
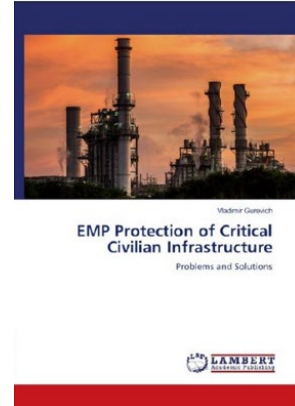
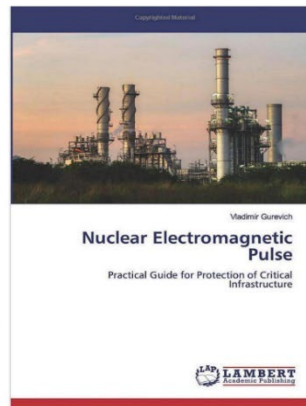
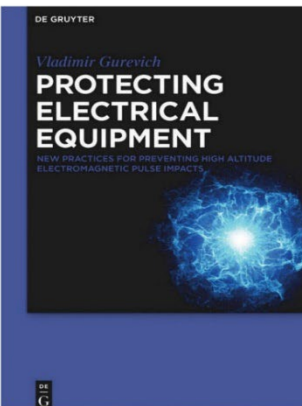
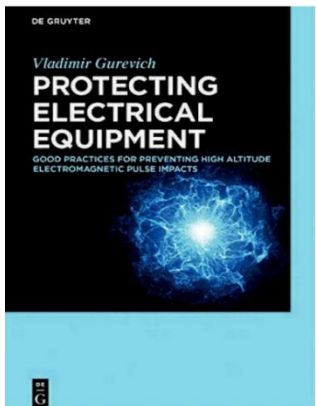
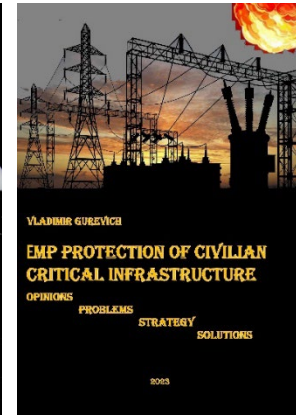
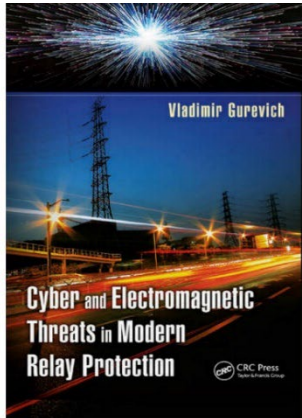
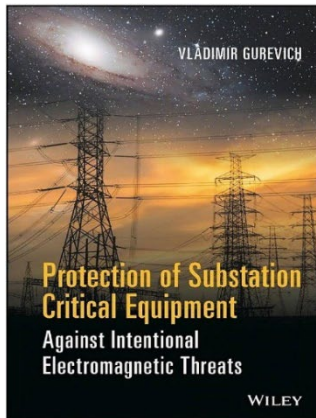
and in the years to come we will still be discussing EMP problems at various forums and lamenting the fact that all critical infrastructure remains unprotected.



My personal contribution to solving the problem



My personal contribution to solving the problem



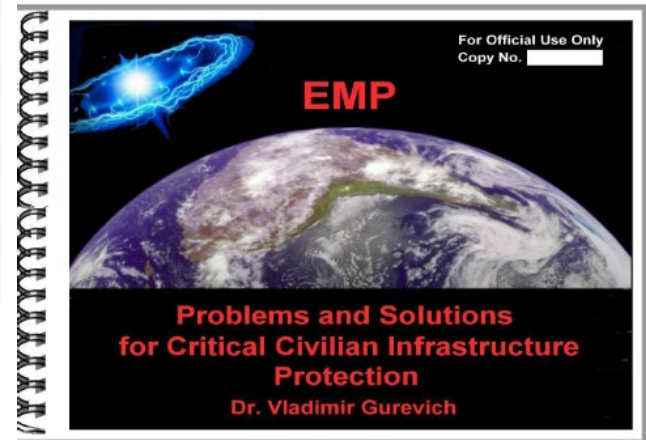
My personal contribution to solving the problem

High Altitude Electromagnetic Pulse: Problems and Solutions for Critical Civilian Infrastructure Protection

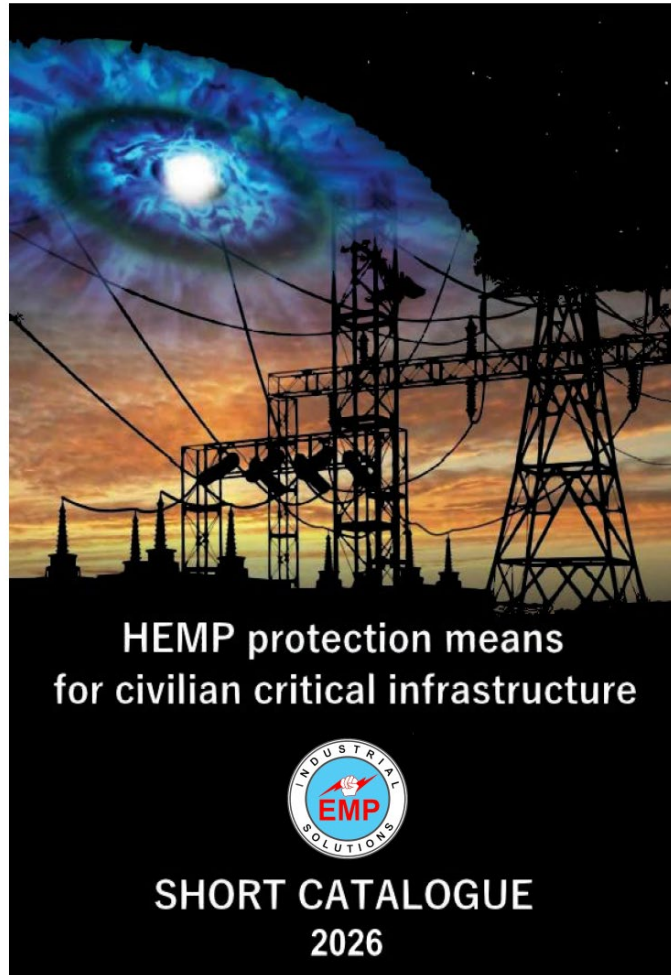
Course Lecture Plan

No.	List of Lectures	Duration, h
1	EMP History	2
2	EMP Characteristics and Parameters	2
3	What Need to be Protected	2
4	EMP Protection Means	2
5	Official Documents, Reports, Standards	2
6	EMP Simulators	2
7	The Problems	2
8	Solutions: Immunity Level Selection	2
9	Solutions: Recommended Equipment for EMP Resilience Testing	2
10	Solutions: Understanding Fakes	2
11	Solutions: New Concept and Protection Means	4
Σ		24

**Full Lecture Book (266 pages)
at the end of the course for
each registered participant**



My personal contribution to solving the problem



Specifically designed for
civilian infrastructure

My personal contribution to solving the problem

NEW PRODUCT

HEMP Protection Modules for Control Cabinets, Relay Protection, Telecommunication



My personal contribution to solving the problem

NEW PRODUCT

HEMP Protection System of High-Power Transformer



My personal contribution to solving the problem

NEW PRODUCT

HEMP Protected Automatic Emergency Backup Industrial Battery Charger for Auxiliary DC Critical Power Network



HEMP Protection and Control System for an Emergency Diesel Generator Powering Critical Substation Auxiliary Electrical Network



My personal contribution to solving the problem

NEW PRODUCT

Auxiliary equipment



Mobile Backup Power Supply for Auxiliary DC Power System Simulation



UPS and Static Switch Tester for Express Test



Simulator of Equipment that Needs to be Protected by EMI/HEMP Filters

My personal contribution to solving the problem

NEW PRODUCT

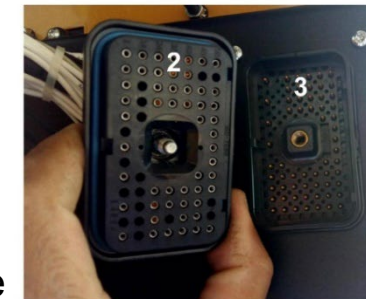
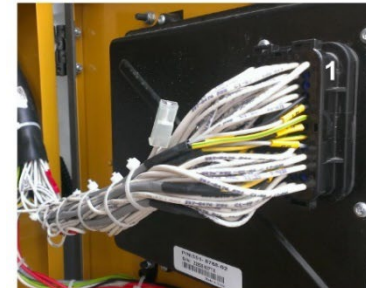
High Power (500 kW) Reserve Diesel-Generator Protection

WINDOWS



WINDOWS

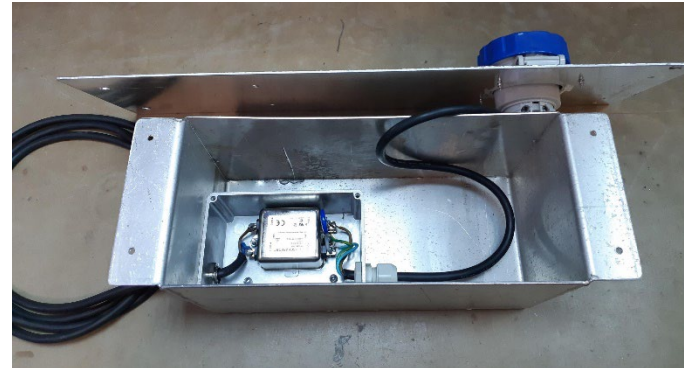
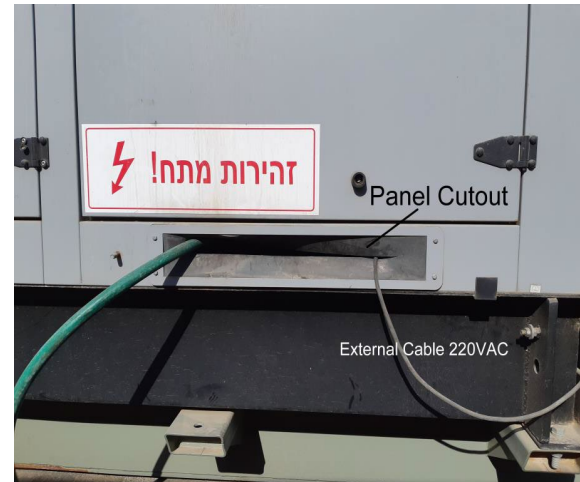
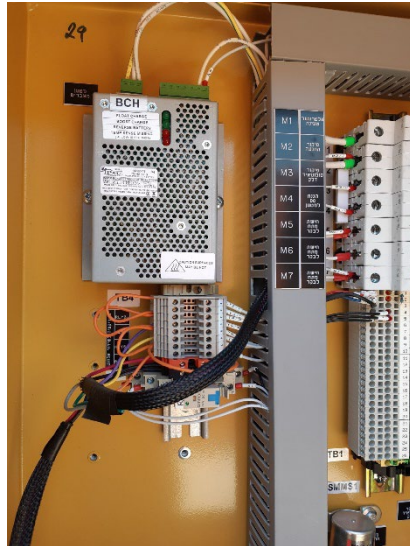
Main Controller Inside



My personal contribution to solving the problem

NEW PRODUCT

High Power (500 kW) Reserve Diesel-Generator Protection



My personal contribution to solving the problem

NEW PRODUCT

High Power (500 kW) Reserve Diesel-Generator Protection

DG 500 kVA



500 kVA Diesel Generator

Protection means mounted and assembled during August-October 2019. At November 2019 DG was successfully tested for full load.

My personal contribution to solving the problem

NEW PRODUCT

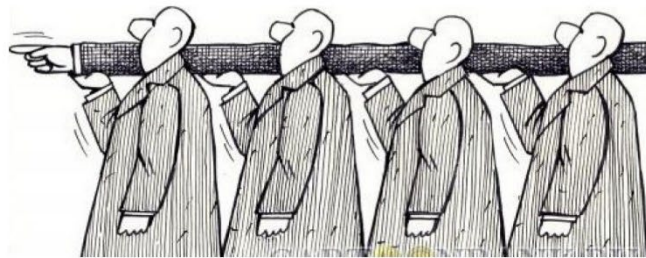
High Power (500 kW) Reserve Diesel-Generator Protection

Honeycomb Ventilation Panels



מצב קיים בארץ לא בסדר!

כל הפיתוחים האלה לא מעניינים
לאף אחד במדינה שלנו...



EMP

מצב קיים בארץ לא בסדר!



זה לא בסדר ולא מקובל שבמדינת ישראל
רק פנסיונר גורביץ' עוסק בבעיה של הגנת על
מערכת חשמל אזרחיות אסטרטגיות מפני EMP
בפועל ולא רק במילים!

The End

**THANK YOU
FOR YOUR
ATTENTION**



Welcome:

<https://www.best-empsolutions.com>